Review of Idling Reduction Technologies

Forward Wisconsin: Reducing Diesel Emissions for the Long Haul

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A U.S. Department of Energy Laboratory
Operated by The University of Chicago

Over 2/3 of our 20 million barrels per day is consumed for transportation.

- Oil imports and prices keep rising
  - **22% imports from Persian Gulf**
- Transport still relies on oil for 97% of its energy

Idling wastes expensive fuel, pollutes the air

- Petroleum use
  - Over 1 billion gallons/year (>$ 2 billion)
    - ~2% of heavy vehicle fuel
  - Equivalent to about 1% of our imports
- Emissions
  - 140,000 t NO_x, 2400 t CO, and 7.6 million t CO_2 from trucks
- Noise
- Engine wear
  - Reduces mileage to overhaul
- Added maintenance costs

Typical locomotive diesel engine
... weighs 46,000 pounds

Many heavy vehicles idle to stay warm

- Trucks
  - To keep fuel and engine warm
  - For resting driver
  - To mask out noises and smells
  - For safety
- Buses
  - To warm up
  - While waiting
- Locomotives
  - So it starts
  - For hotel load
  - To keep battery charged
  - To heat toilet water
  - For air brakes
  - Habit

Several technologies can reduce idling

- Most could be used for all heavy vehicle modes
- All reduce fuel use, emissions, and noise

- On-board equipment
  - Automatic engine stop-start controls
  - Cylinder deactivation
  - Auxiliary power units (APU) and similar devices
  - Cab and block heaters
  - Air conditioners
- Wayside units
  - Single system electrification
  - Dual system (shore power)
  - Fluid circulation systems (bus)

Many trucks idle over 2000 hours a year

- Overnight
  - At truck stops and rest areas (20%)
  - In parking lots
  - On roadsides
  - Near first appointment
  - Home

- Waiting for hours
  - At ports, terminals, delivery sites
  - At border crossings

Scheduling can reduce idling at these locations.

Simple measures can reduce energy demand

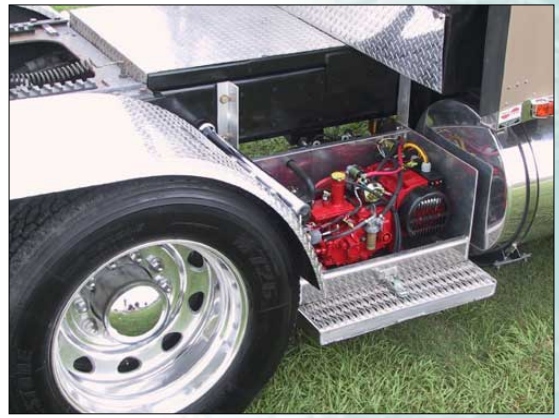
- Reduce heat transfer with insulation
- Reduce solar load with shades
- Recover waste heat from coolant
- Reduce peak with load management
- Can be retrofit or OEM option

Engine controls are inexpensive

- Automatic start-stop senses sleeper temperature
  - Turns engine on when too warm or cold
  - Minimal savings in extreme weather
  - May disturb sleep
  - Adds to engine wear, emissions
  - Cost for factory option or retrofit for $1,200+ truck, $7,500 for loco
- Cylinder deactivation limits combustion to part of engine
  - Enables small reduction of fuel use and emissions
  - Not commercial

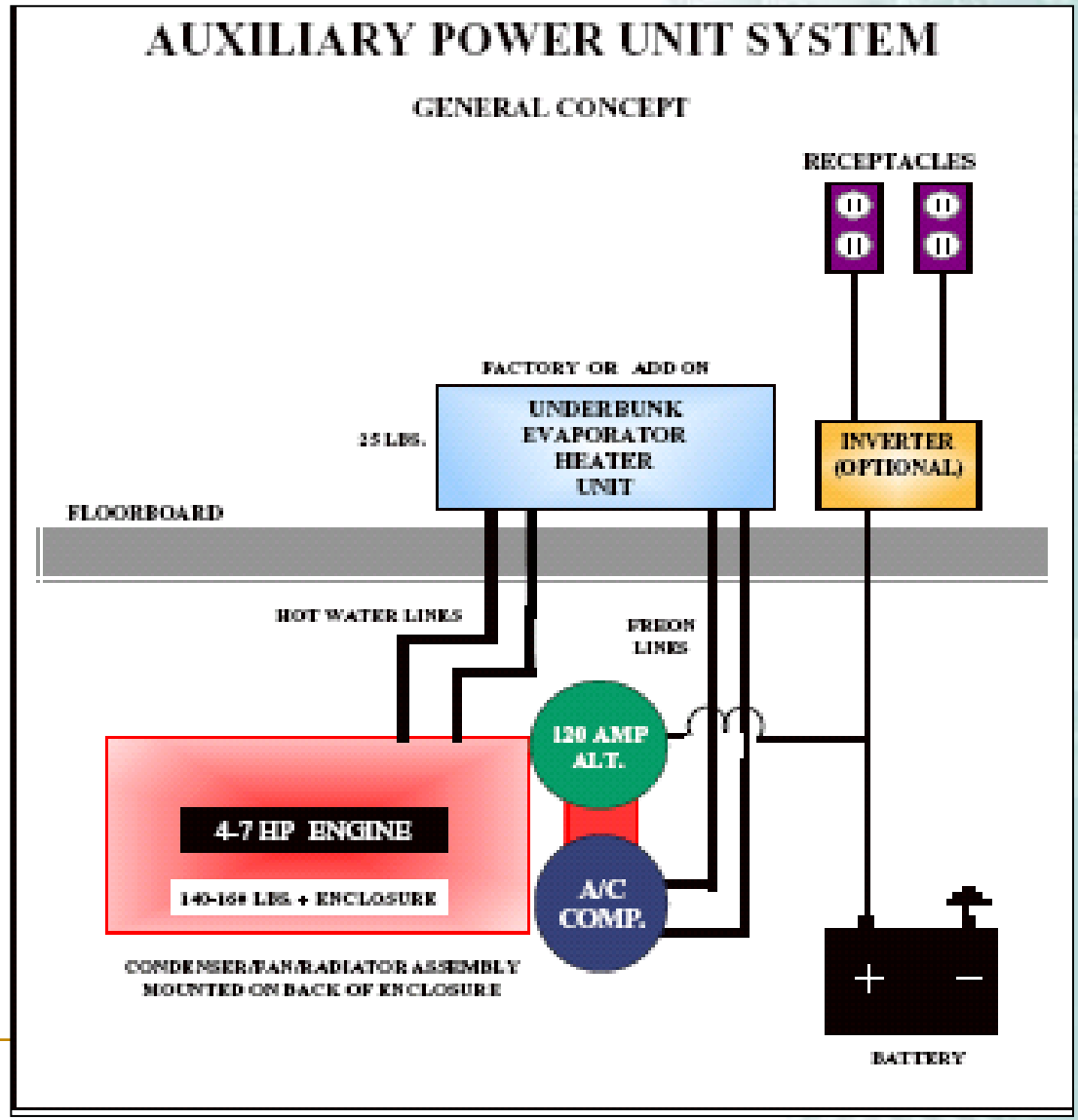
Various on-board designs provide full service

- Supply HVAC, electricity, and charge battery
- Auxiliary power unit (APU) or gen set
  - Diesel-fueled engine and generator
  - Fuel cell
- Inverter/charger with batteries
  - Heat pump system now available



- Typically weigh up to 400 lb and cost ~$7,000+ for truck,
  - $25,000+ for locomotive
- Lighter, less expensive truck units desirable
  - OEM integration is key

APU or gen set relies on small diesel engine

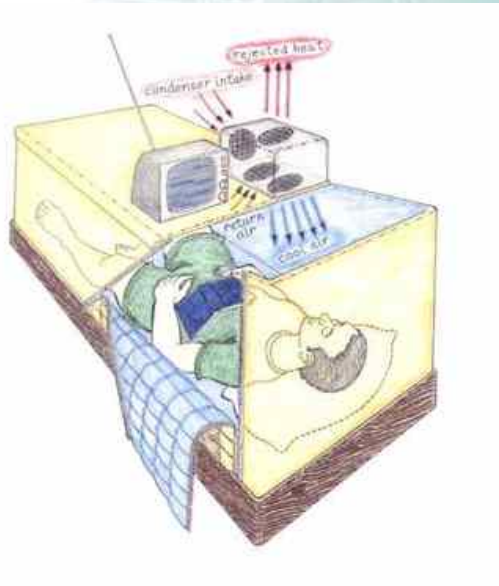


Heaters are available for sleeper and engine

- Small diesel-fueled heaters are efficient
  - Used in Europe, on trucks, buses, boats
- Waste heat recirculation inexpensive

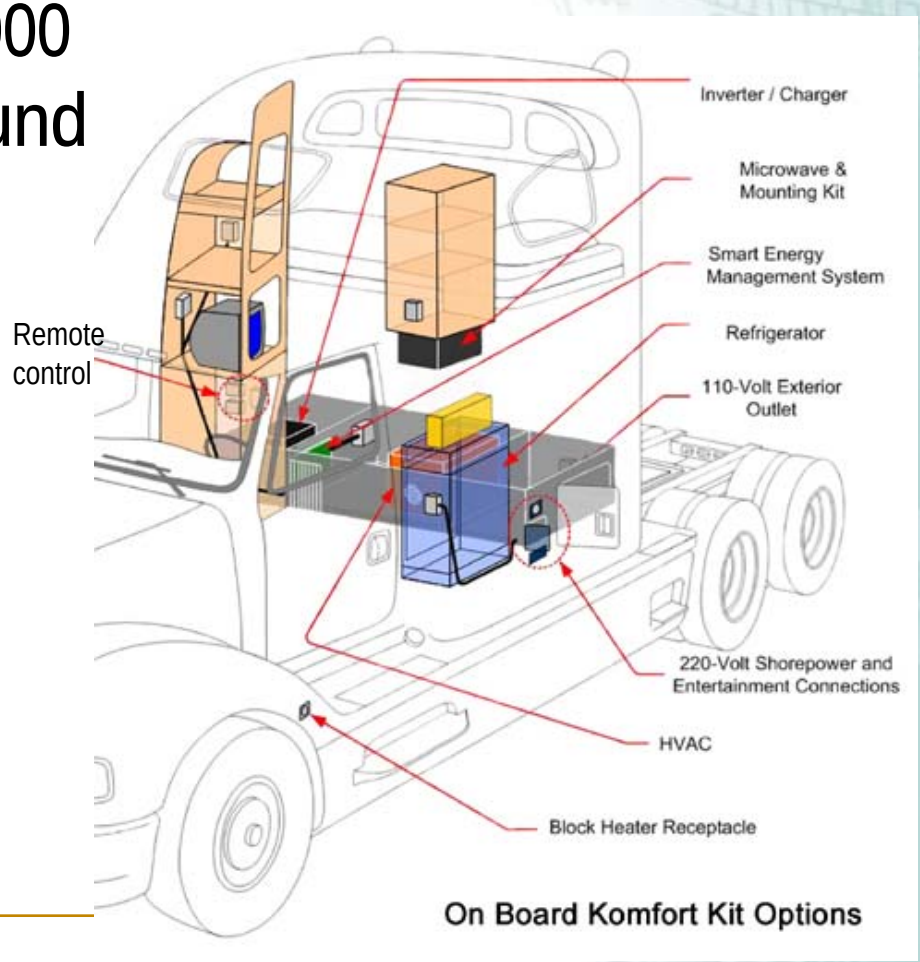
Air conditioners are now on the market

- Most air conditioners rely on batteries
  - One system uses evaporative cooling
  - Thermal storage being developed
  - May just cool bed
- Can install heaters and air conditioners



Dual system TSE* supplies electrical services

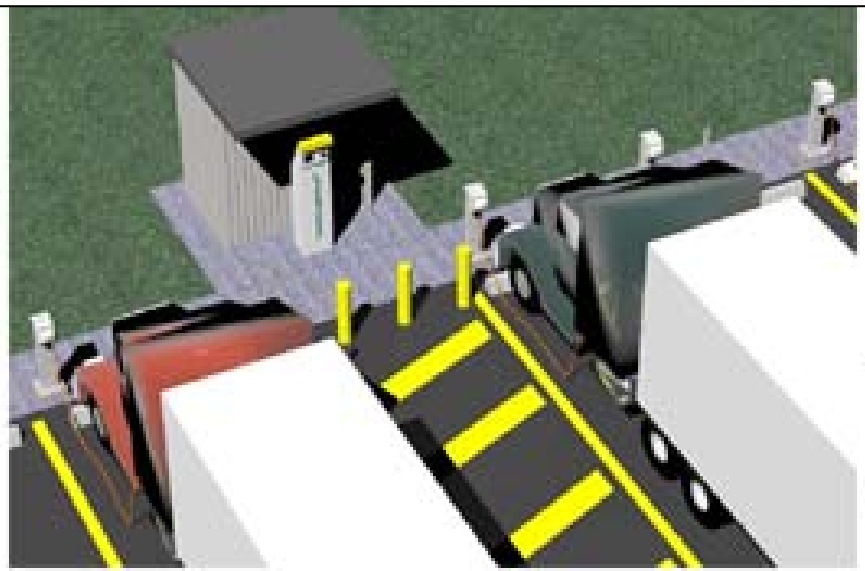
- On-board electric HVAC required
  - Cost up to $8,000
- Parking space costs up to $6,000
- Plug-in pedestal like campground
- Use costs ~$0.50-$1.00/h
- Standardized plugs desirable
  - 120V and/or 240V AC
- Payback <2 years



On Board Komfort Kit Options

***TSE= truck stop electrification**

Dual system TSE is installed in NY



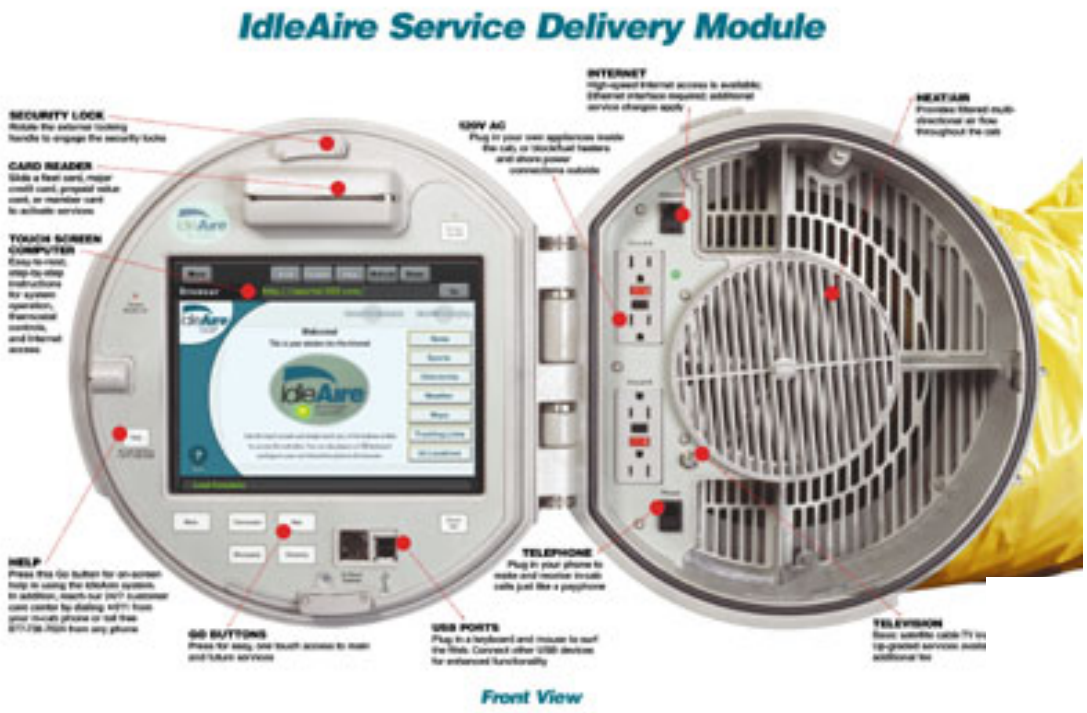
Control Kiosk and Power Pedestal Installations

Single system TSE requires large investment

- User satisfaction high
  - No investment
  - Costs less than fuel
- Capital costs high
  - >$16,000 per space
  - Government grants help fund
- Operating expenses high
  - Requires 9-20 person staff
  - Electricity adds to cost
  - Some revenues to truck stop

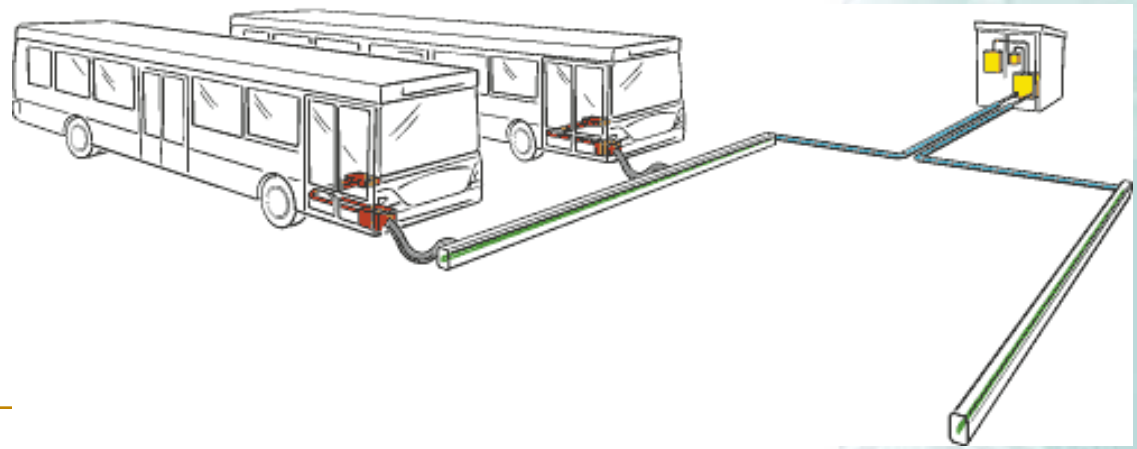
- Pay-per-view and other services add to revenue
  - Revenues only cover operating costs at 5 of 22 locations

This module fits in truck window



Bus idling and its impacts can be reduced

- Hot issue even though energy use and emissions small
  - School buses impact children
  - Tour buses visible at monuments
- Use idle-reduction devices
- Use no-tech solutions
  - Engine can be turned off
  - Revised parking arrangements reduce exposure
  - Alternative fuels reduce emissions



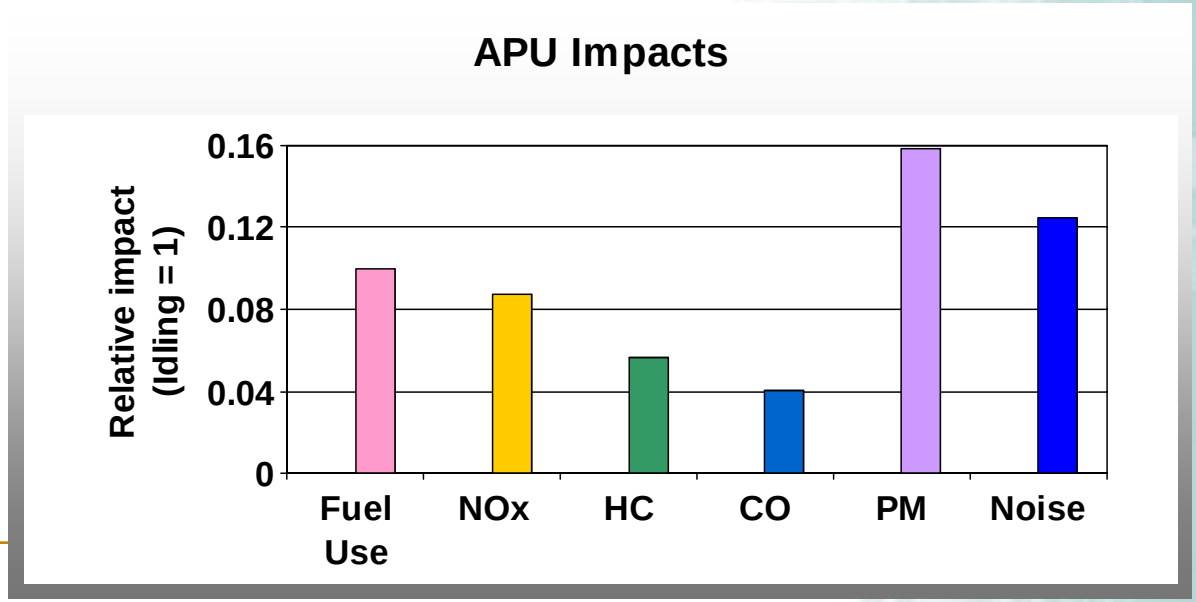
Marine vessels run engines in port

- Ocean-going ships in port
  - Have large power requirements
  - Use on-board generators
  - Low-sulfur fuel oil would reduce emissions
  - Could plug into shore power ("cold ironing")
- Inland marine
  - Ferries use full power to hold to dock
    - Strong-arm docker R&D in progress

Four copper cables supply power from substation

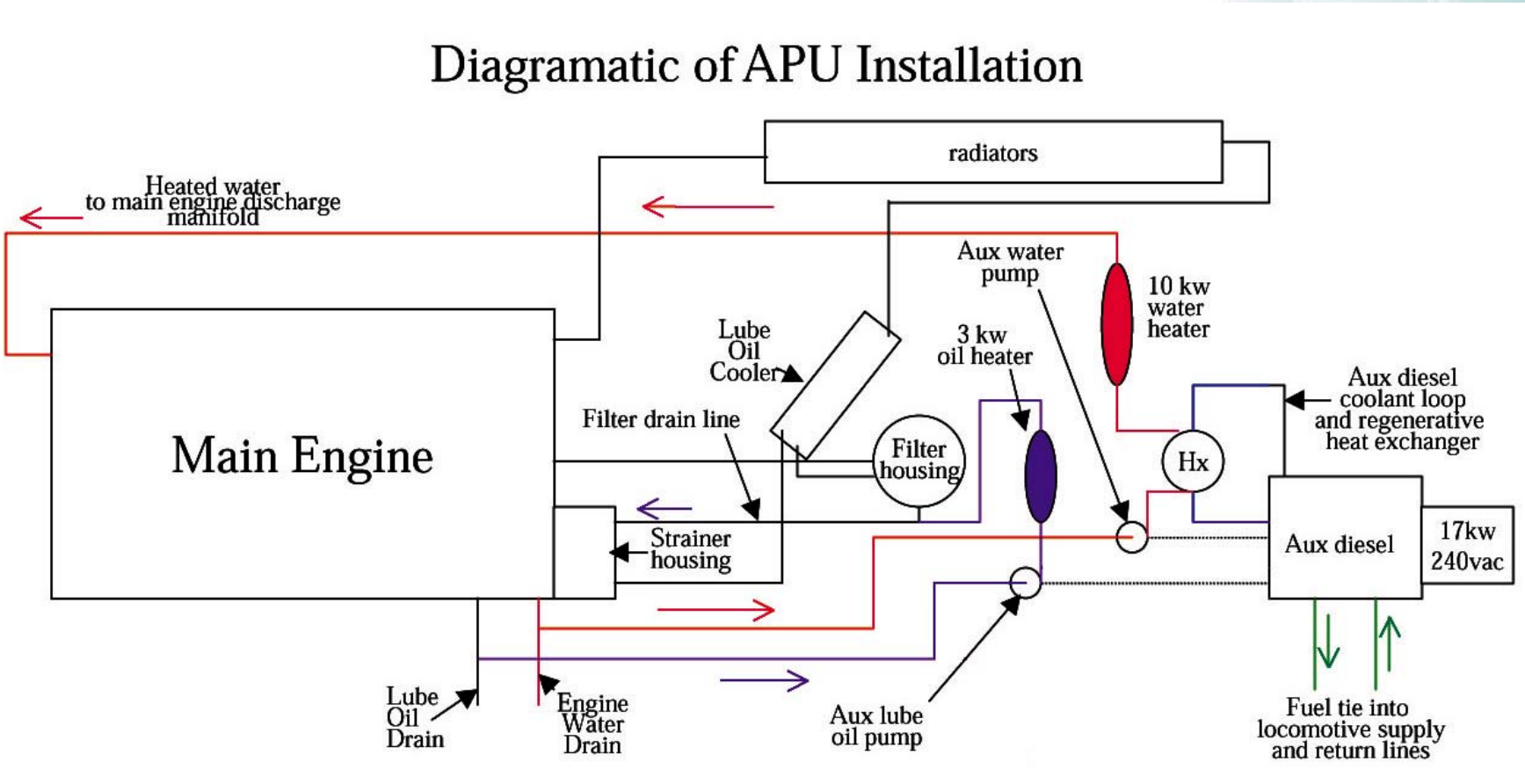
Locomotive installation proceeding rapidly

- Fuel savings make payback rapid
  - Switchers idle 60% of time, line haul almost 40%
- Only 7 companies own 20,000 locomotives
- Limited number of equipment manufacturers
- Retrofit of locomotives common practice
- Idling reduction facilitates NO_x compliance
  - Can sell emission credits*



*See: Trading Locomotive Emissions: A Potential Success Story (AWMA 2002)

Locomotive APU is installed behind main engine



Technologies have pros and cons

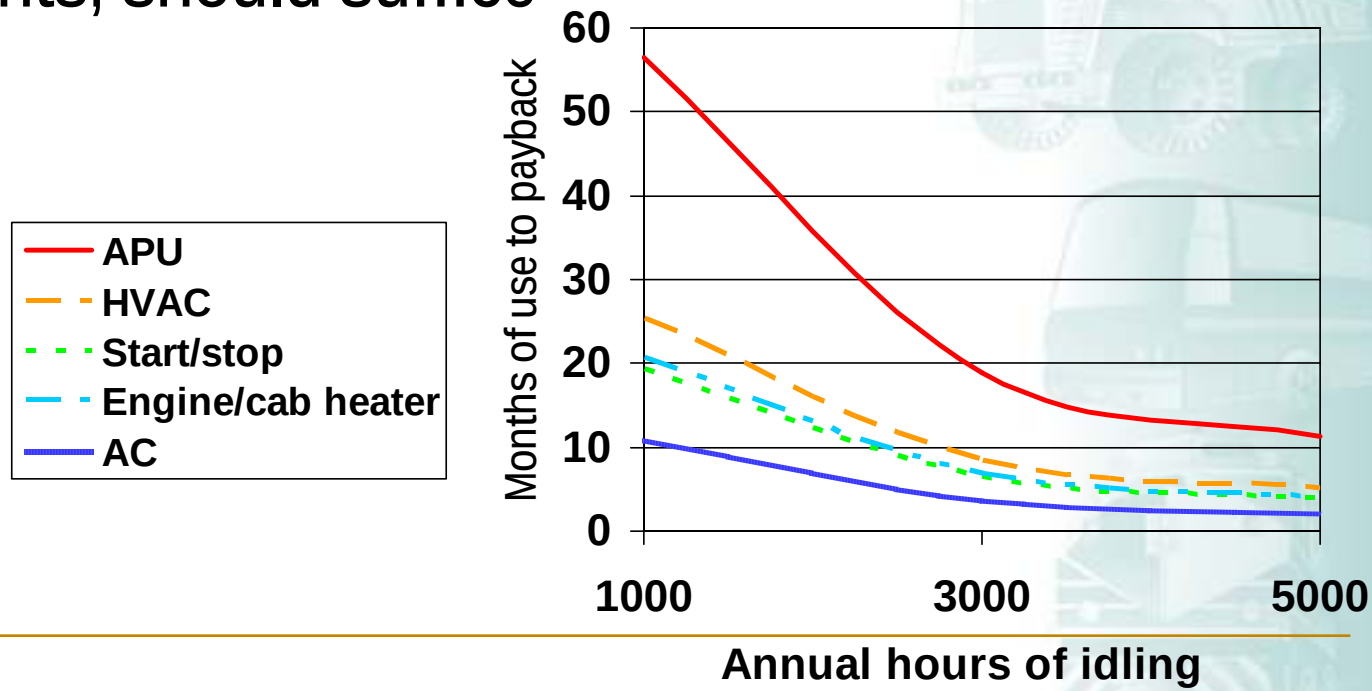
System	Services	Advantages	Disadvantages
Idling	All	No investment	High emissions, noise, fuel use
Automatic start-stop	All, intermittently	Low cost	Noisy, minimal benefit in winter
APU or similar device	All	Anywhere, anytime	High cost and weight
Truck stop electrification	All	Quiet, no local emissions, TV	Requires equipped location, cost
Heater	Heating	Low cost and weight	Not full service
Air conditioner	Cooling	Low cost	Not full service, battery may be heavy

NO ENDORSEMENTS IMPLIED!

Idling reduction can pay for itself

This is win-win situation!

- Vehicle reduces emissions and saves fuel costs
  - Contrast with emission-reduction strategies that increase fuel use
    - These compete for grants on $/ton basis
- Viable business solutions are possible
- Loans, not grants, should suffice



LRAPA Program jump-starts APU installation

- Unusual local program funds on-board technology
- Identified barriers
  - Few dealers or repair shops
  - High initial cost
- Formulated a solution
  - Purchased 100 APUs wholesale
  - Are selling to truckers at discount
  - Provide attractive financing and tax benefits
  - Educating mechanics to install and service with EPA funding
- Contact: Sharon K. Banks (sharon@lrapa.org)

LRAPA
Lane Regional Air Pollution Authority

Thanks Sharon, for several nice pictures!

Several federal funding options are available

- DOT: Congestion Mitigation and Air Quality (CMAQ) Improvement Program
- DOT: State Infrastructure Banks (SIB)
- Transportation Infrastructure Finance and Innovation Act (TIFIA)
  - Private sector participation required if >$100 million
- EPA Supplemental Environmental Projects (SEP)
- DOE technology demonstration projects
- DOE State Technologies Advancement Collaborative (STAC)
- DOE State Energy Program projects

NATIONAL IDLING REDUCTION PLANNING CONFERENCE

Developing comprehensive, nationwide solutions for heavy-vehicle idling reduction

MAY 17-19, 2004
ALBANY, NEW YORK

- 214 people attended from
  - Government agencies at all levels
  - Industry: users, truck stop operators, manufacturers
- All relevant topic areas were covered
  - Technology and research
  - Legislation and regulation
  - Energy, environmental impacts, and economics
- Coordinated action was achieved
  - Multi-agency sponsorship (DOE, EPA, DOT, DOD, NYSERDA)
  - Stakeholders are writing National Idling Reduction Plan covering education, financing, regulations, and technology

For more information see websites

- National Idling Reduction Network News (monthly): http://www.eere.energy.gov/vehiclesandfuels/resources/fcvt_national_idling.shtml
- ANL idling publications: www.transportation.anl.gov/idling.html
- DOE Advanced Vehicle Testing Activity demos: www.ott.doe.gov/otu/field_ops/idle.html
- DOE Clean Cities: www.eere.energy.gov/cleancities/idle/
- EPA Smartway Program: www.epa.gov/smartway/
- State regulation table: www.epa.gov/orcdizux/retrofit/documents/s03002.pdf
- Proposed TSE standards notice (Federal Register): a257.g.akamaitech.net/7/257/2422/06jun20041800/edocket.access.gpo.gov/2004/pdf/04-15534.pdf
- DOT CMAQ Program: www.fhwa.dot.gov/environment/cmaqpgs/
- State Infrastructure Bank: www.fhwa.dot.gov/innovativefinance/sib.htm
- Transportation Infrastructure Finance: tifia.fhwa.dot.gov
- NYSERDA demonstrations: www.thruway.state.ny.us/commercial/truck-elec/truck-elect.html
- CARB activities: www.arb.ca.gov/msprog/truck-idling/truck-idling.htm
- MorElectric Truck: digitalthink.breezecentral.com/p99853739/

Thank you

- Sid Diamond – DOE FreedomCAR and Vehicle Technologies
- Frank Stodolsky- ANL

- Disclaimer: no endorsements are implied!
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